DEC STD 009-2 Product Engineering Specifications: Reliability, Availability, and Maintainability Parameters

DOCUMENT IDENTIFIER: A-DS-EL00009-02-0000 Rev C, 08-Nov-1991

ABSTRACT: This standard establishes minimum requirements for specifying reliability, availability, and maintainability parameters in hardware product specifications. A figure is included that shows a suggested format to aid in specifying the parameters.

APPLICABILITY: The use of this standard is mandatory for all systems, options, field replaceable units, and components.

STATUS: APPROVED 08-Nov-1991; use VTX SMC for current status.

This document is confidential and proprietary, and is the property of Digital Equipment Corporation. It is an unpublished work protected under applicable copyright laws.

© Digital Equipment Corporation. 1990, 1991. All rights reserved.

DEC STD 009-2 Product Engineering Specifications: Reliability, Availability, and Maintainability Parameters

DOCUMENT IDENTIFIER: A-DS-EL00009-02-0000 Rev C, 08-Nov-1991

REVISION HISTORY:	Rev A,	18-Aug-1983	
	Rev B,	02-May-1985	ECO Number APO01
	Rev B1,	28-Feb-1990	ECO Number CTS02
	Rev C,	08-Nov-1991	ECO Number NRO03

Document Management Category:	Reliability Testing (HTR)
Responsible Department:	Chief Engineer's Office
Responsible Person:	Ed Hoover

APPROVAL: This document has been reviewed and recommended for approval by the DEC STD 009-2 Advisory Committee and the General Review group for its category.

Ed Hoover, Chief Engineer's Office

Eric Williams - Standards Process Manager

Direct requests for further information to:

Ed Hoover
Use $ VTX ELF for the latest location information.

Use VTX SMC to order copies of this document from Standards and Methods Control. Send distribution questions to JOKUR::SMC or call DTN: 234-4423.

The DIGITAL logo is a trademark of Digital Equipment Corporation.

CONTENTS

1 INTRODUCTION 1
1.1 Purpose 1
1.2 Scope 1

2 RESPONSIBILITIES 1
2.1 Product Team 1
2.2 Design Engineering 2
2.3 Marketing and Digital Services 2
2.4 Manufacturing 3

3 REQUIREMENTS 3
3.1 Environmental and Functional Conditions 3
3.2 Additional Parameters 3
3.3 Field Replaceable Units 3
3.4 Definitions of Figure 1 Terminology 5

Appendix A REFERENCED DOCUMENTS 7

A.1 EL-Class Digital Documents 7

FIGURES

1 Product Parameter List—Sample Format 4

1 INTRODUCTION

Product engineering specifications provide the requirements for design, production, installation, operation, and maintenance of Digital products. This standard covers the reliability, availability, and maintainability parameters that must be included in a product engineering specification. A figure showing a suggested format to aid in specifying the parameters is included.

1.1 Purpose

This document defines the minimum requirements for specifying reliability, availability, and maintainability parameters in product engineering specifications.

1.2 Scope

This standard applies to all systems, options, field replaceable units (FRUs), and components.

For products such as externally purchased components and materials that do not have a product engineering specification of their own, all applicable reliability and maintainability parameters shall be explicitly stated in a higher level assembly specification.

This standard does not address the following:

- Measurement of product performance
- Methods or provisions to determine product compliance with specified requirements
- Software products

2 RESPONSIBILITIES

The following paragraphs identify the groups responsible for specifying the product specification parameters and for ensuring product compliance.

2.1 Product Team

The Product Team shall be responsible for the following.

- Specifying all reliability, availability, and maintainability parameters
- Updating the parameters if there is a change in the condition(s) on which they were based
- Reviewing reliability, availability, and maintainability inputs from all groups at each phase of the Phase Review Process
- Resolving conflicts concerning program goals

The Product Team is defined in *DEC STD 028-0 Phase Review Policy*.

2.2 Design Engineering

Design Engineering shall be responsible for the following.

- Designing the product to meet the requirements of the product specification
- Providing reports to the Product Team relative to meeting the specified product goal(s)
  - — Reports shall be provided at each stage of the Phase Review Process.
  - — Reports shall contain data based on math models or assessment of test results appropriate to the phase being reviewed.
- Notifying the Product Team when the analyses indicate that specified product goal(s) may not be met

2.3 Marketing and Digital Services

Marketing and Digital Services shall be responsible for the following.

- Providing the Product Team with market and customer service considerations to aid in specifying the reliability, availability, and maintainability requirements
- Notifying the Product Team of any changes in the market conditions which may impact the specified requirements

Marketing and sales shall consider the effects of reliability, availability, and maintainability on the following.

- Digital's competitive edge
- Customers' expectations
- Sales volumes

Digital Services shall consider the following.

- Anticipated warranty activity
- Competitive reliability and service product analyses
- Overall life cycle cost to the customer
- Service contract penetration
- Cost of maintenance
- Wearout replacement strategy

2.4 Manufacturing

Manufacturing shall be responsible for the following.

- Providing the Product Team with Manufacturing's plans for ensuring compliance with the product specification.
- Providing reports to the Product Team relative to meeting the specified product goal(s) and the effects of the requirements on the manufacturing process. The reports shall include the following provisions.
  - — Preventing or removing infant mortality failures
  - — Assessing wearout
  - — Controlling purchased material
  - — Evaluating the effects of the specified requirements on cost, capacity, schedule, and process design
  - — Continual monitoring and evaluation of product performance

3 REQUIREMENTS

The focus of this paragraph is Figure 1, which shows a sample format for the minimum set of parameters to be specified.

Subheads 3.1 through 3.4 provide introductory and background information for Figure 1.

- Subhead 3.1—Environmental and functional conditions under which parameters must be measured
- Subhead 3.2—Additional parameters that may be included in the product specification
- Subhead 3.3—Parameters that must be specified at the FRU level
- Subhead 3.4—Definitions of terms used in Figure 1

3.1 Environmental and Functional Conditions

The environmental and functional conditions for which the parameters are valid shall be specified. Unless otherwise noted under the dependencies column in Figure 1, the parameters shall apply under all environmental and functional conditions defined in the product engineering specification.

3.2 Additional Parameters

Parameters, in addition to those listed in Figure 1, may be included in the product specification provided the intended environmental and functional conditions are also specified.

3.3 Field Replaceable Units

For products that contain FRUs, the following parameters shall be specified at both the system level and the FRU level.

- Mean Time Between Failure (MTBF)
- Annualized Failure Rate (AFR)

- Mean Time To Repair (MTTR)

Figure 1: Product Parameter List—Sample Format

Product Name:				
Parameter		**Value**	**Units**	**Dependencies**
ADT			Minutes	Response Time: MTTR:__ Hr MTBF:__ Hr
Availability			%	
AFR			%	PODC:__% Temperature:__ ° C Humidity:__ % FDC:__%
MTBF			Hours	
Env Class				Per DEC STD 102
Error Rate				
MTTR			Hours	Repair time: __ Hr
Percent Survival	90%			Units depend on the nature of product (cycles, hours, characters printed)
	n%			
Service Life			Years	
Product Life			Years	

Legend

ADT = Annualized downtime
AFR = Annualized failure rate
FDC = Functional duty cycle
MTBF = Mean time between failures
MTTR = Mean time to repair
PODC = Power on duty cycle

3.4 Definitions of Figure 1 Terminology

The definitions of terms are presented according to the layout of the sample format.

- Column headings
- Dependencies
- Parameters

Column Headings

Parameter: A variable that is specified by a value and dependencies.

Value: A quantitative measure of a variable.

Units: The units of measure associated with the value.

Dependencies: Specific conditions under which the parameter is measured.

Parameters

ADT: Annualized downtime is a reliability metric based on availability. ADT is equal to the amount of time per year that a product is unavailable. ADT, in minutes, is calculated as follows.

$$525,600 \times Downtime / (Downtime + Uptime)$$

AFR: The annualized failure rate is a reliability metric based on the MTBF. The AFR is expressed in percent, which equals the total number of hours in one year (8760 hours) divided by the MTBF (hours) and multiplied by 100.

Availability: The probability that the product or system will be available to do user tasks when required. Availability is calculated as follows.

$$Uptime / (Uptime + Downtime)$$

Env Class: The environmental class as defined in *DEC STD 102-0 Environmental Standard for Computers and Peripherals - General Test Requirements*.

Error Rate: The ratio of the number of incorrectly processed items to the total number of processed items. Examples of processed items are the number of seeks, characters printed, characters transferred, and so forth.

MTBF: The average time between failures of a product (device, unit, subsystem, or system) having no manufacturing induced defects and operated within the specified environmental limits.

Percent Survival: The percentage of items that continue to function beyond a specified point in the product's life. At a minimum, 90% shall be specified for products that wear out or whose expected life is less than the useful life of the product. It is recommended that two points, 90% and n% survival levels, be specified to define the wear-out characteristics more precisely. The units of product life used in specifying the percent survival parameter will depend on the nature of the product. Examples of units are hours, cycles, and numbers of characters printed.

Product Life: The expected useful life of a product before obsolescence or wearout would require replacement or refurbishment.

Service Life: The time that Digital Services is obligated to provide service for the product.

Dependencies

FDC: Functional duty cycle is a measure of the operational condition of a product and depends on the nature of the product. Examples of functional duty cycles are tape motion, seek, transmit.

Humidity: The ambient humidity or humidity range.

MTTR: Mean time to repair is the average time required to diagnose a fault, effect a fix, and perform a verification of the fix.

PODC: Power on duty cycle is the percentage of time the unit is on.

Response Time: The Digital Services response time required to meet the availability parameter.

Temperature: The ambient temperature or temperature range, in degrees celsius.

APPENDIX A REFERENCED DOCUMENTS

A.1 EL-Class Digital Documents

EL-Class Number	Document Title
EL-00028-00	*DEC STD 028-0 Phase Review Policy*
EL-00102-00	*DEC STD 102-0 Environmental Standard for Computers and Peripherals - General Test Requirements*

Use VTX SMC to order copies of EL-class documents from Standards and Methods Control. Send distribution questions to JOKUR::SMC or call DTN: 234-4423.

READER COMMENTS

Your comments and suggestions will help Standards and Methods Control improve their services and documents.

Did you request this document? _____ If so, did it arrive within a satisfactory period of time? _____ Please comment.

What are your impressions of this document? Consider format, organization, completeness, readability, and illustrations.

————————FOLD ON THIS LINE———————————————— -

Did you find technical or clerical errors in this document? If so, please specify the page number(s) and the error(s).

Are the instructions for the update package clear? _____
Was an index available? _____ If not, is one needed? _____
Do you have other suggestions for improving this document?

The following information is optional:

Name _____ Mailstop _____

Department _____ Node _____

Send your comments to JOKUR::PROJECTS, or fold, staple, and send this page through interoffice mail to:

READERS' COMMENTS
STANDARDS AND METHODS CONTROL
NRO4/D4